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ABSTRACT

Twenty-seven activities dealing with the marine environment of the Great Lakes are presented. Designed for junior and senior high school students, these activities develop awareness of the biological, physical, social, economical, and aesthetic dimensions of the Great Lakes. Field trips, films, discussion, and hands-on activities are used to teach the students about a variety of topics including ports, shipping, wastewater treatment, sunken treasure, geography, recreational and occupational skills, energy, pollution, fish, art, and ecology. The format for the activities varies, but information may include objectives, materials, learning activity, student directions and handouts, contact person for field trips, and background information. (DC)

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A Sourcebook of Marine Activities Developed in the Milwaukee Great Lakes Summer Education Program, 1977 and 1978

1977

Principal Authors

Donald Shebesta

Beth Sieckman

Scott Temperly

1978

Principal Authors

Kevin Koch

Robert Peters

James Williams

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U.S. DEPARTMENT OF EDUCATION
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INTRODUCTION

The activities in this guide are intended to stimulate marine education in schools and other community programs. They were developed for junior and senior high age youth and are intended to develop an awareness of the marine environment of the Great Lakes including its biological, physical, social, economic, and aesthetic aspects. Beyond the level of awareness, skills are introduced to provide a recreational and career orientation.

These activities were developed by the members of the staff of the Great Lakes Summer Education Program during the summers of 1977 and 1978. This program was funded by the University of Wisconsin Sea Grant College Program in response to suggestions from members of an advisory committee composed of Milwaukee educators and community leaders. The site for this program was the University of Wisconsin Great Lakes Research Facility located in the Milwaukee harbor.

In 1977 the staff met in planning sessions for four weeks in late June and early July. Then the materials were tried out in two-week sessions with twenty five students in the first, and thirty students in the second session. The materials were evaluated and modified as instruction proceeded. In 1978 a new staff met for eight days in June and then conducted three sessions of two weeks duration.

GENERAL OBJECTIVES OF THE PROGRAM

The over-all purpose of the Great Lakes Summer Education Program was to develop curriculum materials dealing with marine environment of the Great Lakes which can be used with junior and senior high school age youths. The activities which resulted are intended to develop an awareness of the marine environment of the Great Lakes including its biological, physical, social, economic and aesthetic aspects. Career orientation has been presented throughout the program. Beyond the level of mere awareness, specific skills are introduced which are related to recreational and occupational activities.

It is intended that these activities will serve as the stimulus for marine education in schools and in various other community programs.

THEMES RUNNING THROUGHOUT MARINE EDUCATION

In constructing a program of marine education one must integrate the learning experience which appear in this source book as discrete activities around certain conceptual themes which unify the experiences from the viewpoint of students. The themes which can be used to organize these Great Lake studies are:

I. The Natural Environment

- A. The physical setting of the Great Lakes and how it developed over long periods of time
- B. Varieties of living things: identification and description
- C. Interactions between living things and their physical environments:
  varieties of habitats
- D. Interdependence of living things
- E. Interactions between elements of the physical environment: land, water, and atmosphere
- F. Interactions between humans and the living and physical elements of the environment

II. The Social and Economic Environment

- A. The geographical significance of the Milwaukee harbor located at the confluence of three rivers
- B. The history of our use of the Great Lakes: how and why we are here
  1. Transportation and commerce

2. The lake as a source of food and water

3. The lake as a place for waste disposal

4. Recreational uses of the lake

5. Careers related to Great Lake activities

III. Aesthetic Qualities of the Environments

A. The lake and shoreline as a source of beauty

B. The enjoyment of living and working near and on the lake

1. TOUR OF THE MILWAUKEE HARBOR

Objective

To provide an overview of the Milwaukee harbor and develop an awareness of its geographical, commercial, historical, and recreational features.

Activity

Students and instructors use a commercial touring vessel which regularly provides harbor tours for the public. This tour provides an opportunity to observe such features as the operation of bridges in the Milwaukee River, grain elevators, petroleum storage areas, shipping terminals, and the breakwater.

Prior to the tour it is important that the instructors themselves become familiar with the important features of the harbor. They should take the tour themselves with someone who is an expert. A former port director provided this service for the instructors in this program.

Note

Since this activity provides an overview of the harbor it is suggested that it be one of the first activities in any program. Another activity is to take the students to the observation deck on the top floor of the First WMsconsin Building, the tallest building in the city, to view the harbor shoreline and lake.

2. SCUBA, SNORKEL, AND WATER SAFETY

Objectives

1. To evaluate individual students' swimming skills in order to establish a safe environment within the program.
2. To introduce skills related to snorkeling.
3. To teach knowledge and skills related to water safety including use of ring buoy, shepards crook, and life jackets.
4. To introduce scuba as a recreational activity. (No attempt is made to present an entire scuba program.)

Activity

A professional scuba instructor is employed to give a short presentation of scuba equipment and give a true representation of the training background needed for qualified scuba divers. The instructor displays various pieces of equipment and explains each concluding with a short demonstration in the water. For this activity the class meets at a swimming pool with swimming suits and towels.

After the scuba demonstration the students are divided into small groups for the following activities.

1- Students (in the shallow end of the pool) are introduced to mask and snorkel clearing.

2- Students are introduced to the use of extention lifesaving equipment such as shepards crook and ring buoy (as suggested by the American Red Cross) and mouth to mouth resuscitation.

3- Students are taught how to jump into the water while wearing a life jacket.

4- Students view a slide presentation dealing with understanding photography, and marine life.

3. UNDERWATER PHOTOGRAPHY

Objective

To introduce the students to the nature of the equipment used in underwater photography, its various applications, and the skills required for its use.

Materials

35 mm camera and underwater housing

126 camera and underwater housing

light bar holding several battery-powered lights

Activity

For this activity the class meets at a swimming pool with bathing suits and towels

Students view a demonstration of the equipment by a diver. Principles of underwater photography are discussed. Then students are shown a motion picture of underwater scenes made by the diver. Finally, they are given the opportunity to use the camera underwater.

Student Directions and Information

UNDERWATER PHOTOGRAPHY
by
Marcel Lachenmann
Milwaukee Public Schools)

Underwater photography is not new. The first underwater photograph was made in 1872; the first underwater movie was made in 1919; and the

first underwater color photograph was made in 1930. With the growing popularity of scuba diving, underwater photography has become a popular sport.

Virtually any camera can be taken underwater. There are cases for Instamatics, movie cameras, and even Polaroids! Most cameras are taken underwater in waterproof cases. These waterproof cases are of three basic types: glued plastic, molded plastic, and metal. The glued plastic cases tend to develop leaks with age. The metal cases are heavy and are prone to fogging in cold water. The most popular case today is the molded plastic case.

Whatever type of case is used, care must be taken to have the O-ring very clean and greased with silicon grease. Unless this is done, the case may leak! Another way to take underwater pictures is with an amphibious camera called the Nikonos. This camera is completely waterproof and needs no case. It is popular in underwater photography, photography in damp areas, and in medical photography (never drop your own camera into boiling water to kill germs).

******** ******** ******** ******** ********

In underwater photography the basic rules of regular photography also hold true. Some of these basic rules are the following:

1. Push the shutter release gently. This prevents camera shake and results in a clear photograph.
2. Make sure you can see your subject in the camera viewer. It is best to leave some space around the subject. The reason for this is that some cameras take a picture slightly differently than what you see. This is called parallex.

3. Make sure that you focus your camera. If your camera has fixed focus, stay the correct distance from your subject. Most instamatic cameras take the clearest picture at 10-12 feet.
4. Watch your background. Mergers can occur - a merger occurs when the background and the subject blend together with poor results. Examples of some types of mergers are the following:
   a. A color merger--a black cat on a pile of coal
   b. An object merger--a tree in the background appears to grow from the head of a person in the foregroued.
   c. A border merger--(also called parallex) A persons head is cut off at the top.
5. To add depth to your photos, include foreground.
6. Never put the horizon in the middle of the picture.

**** **** **** **** **** **** ****

When you take a picture, light enters the camera and causes a chemical change on film. Some films need more light to take a picture than do others. The amount of light needed by a film to take a picture is indicated by its ASA number. The higher the ASA nmmber the less light is needed to take a photograph. Thus, the ASA of the film that you use will determine how much light is needed.

On adjustable cameras the amount of light that enters a camera is determined by a shutter speed and an F stop. The shutter speed is merely how quickly the camera opens and closes to light. It is usually indicated by a number like 30, 60, 125 etc. These numbers on a camera are fractions and thus 30 is 1/30 second. F stops refer to the opening of the lens. The lower the F number the bigger is the opening of the lens and the more

light will enter. The photographer usually determines the shutter speed and F stop setting by using a light meter.

**** **** **** **** **** **** ****

One of the major problems faced by the underwater photographer is light. Water affects light in several ways:

1. Water filters out the colors of light. Normally sunlight consists of all the colors of the rainbow. But as light travels through water various colors are filtered out by the water. In just 10 to 15 feet of water you lose the yellows and reds in sunlight. This means that a red object appears black in 20 to 30 feet of water. As you go deeper the colors turn primarily green and blue. The last color to be lost is blue.

   Thus if a photographer wants natural-color underwater, artificial light must be used. The easiest way to do this is with a flash or strobe. Underwater movie lights tend to be very heavy and quite expensive. Ordinary flash cubes can be used underwater.

   Another way of getting some better color in underwater photography is to use a reddish filter. The common filter used in underwater photography is rose colored and is called a CC30R filter.

2. A second problem that occurs underwater is the problem of suspended materials. For example: take a handful of dirt and drop it in the air. It falls to the ground and the air is still clear. Now drop the dirt in the water. Some of it will drop to

the ground but much of the dirt will be suspended in the water and make the water cloudy. This cloudy condition will make photography difficult.

Water can suspend dirt, algae, etc. For this reason, an underwater photographer tends to move in close to the subject. When you move in close, however, it is difficult to show large subjects. Thus underwater photographers tend to use cameras with wide angle lenses. A wide angle lens will show a greater view and thus you can be quite close and still photograph large subjects.

3. A third problem is the critical angle of water. This sounds complicated but it does not need to be. Have you ever looked at a lake at sunrise or sunset and seen the water reflecting the sun? Did you ever look into a puddle and have it act like a mirror? When light hits water, some of it is reflected. Light penetrates into water best when the sun is directly overhead. Thus in early morning or in late afternoon, it may be totally dark underwater. The light is being reflected. Thus many photographers take underwater pictures only during the hours of 10:00 AM to 2:00 PM as these are the times when the light will penetrate best into the water.
4. A final problem is the flash. Water does not allow the light to pass through it as easily as does air. Water absorbs some of the light's energy. Thus you must be very careful to be the right distance for the flash. If your subject is just a few feet

farther from the camera than is recommended, then your picture will be dark.

In air the light power of a flash varies inversely with the square of the distance. To put this in simple terms . . . if you are using a camera with a flash that is set for 10 feet away and you take a picture at 20 feet away (2x the normal distance), you would need 4 flash bulbs going off at once to get the picture. But in clear water the power varies with the cube of the distance. Thus if your camera was set for 10 feet away and you shot a picture at 20 feet, you would need 27 bulbs going off at once.

As you can see, the distance is very important when using a flash.

4. TOUR OF SHIPPING TERMINALS

Objective

To enable students to observe several large shipping terminals in Milwaukee Harbor which are used in international trade.

Activity

The students can be taken on a tour of several docks and loading facilities by an official in charge of terminal activities for the Meehan Seaway Service, Ltd. Dockside activities will be explained and students will have an opportunity to observe the loading and unloading of ships and the movement and storage of freight in the terminal buildings. Job opportunities relating to shipping should be discussed.

Contact

(1) Meehan Seaway Service, Ltd.
1500 S. Lincoln Memorial Drive
Milwaukee, Wisconsin 53207

(2) Mr. Alvin Brown, Traffic Representative of the
Port of Milwaukee
500 N. Harbor Drive
Milwaukee, Wisconsin 53202

5. INTERESTING HIGHLIGHTS OF THE PORT OF MILWAUKEE

Objectives

To provide general information about the commercial activity in the Milwaukee Harbor.

To identify for the students the principal inbound and outbound commodities of the Port of Milwaukee.

Materials

Each student can be given a handout specifying interesting highlights of the Port of Milwaukee. Examples appear below.

Activity

This activity can follow the tour of the Shipping Terminals. After the contents of the handouts are discussed, the students can be given two word search puzzles. These puzzles contain the names and goods which are received and sent from the Port of Milwaukee.

INTERESTING HIGHLIGHTS ABOUT THE PORT OF MILWAUKEE

HARBOR COMMERCE: Approximately 4 million tons. The Municipal Harbor Terminals handle about 41% of the total Port commerce. The balance is handled at private docks.

SHIPS: About 4,500 large ships call here each year--an average of 12 per day, including ocean ships, lake freighters, carferries, tankers, passenger ships, and many others. More diversified shipping can be seen in Milwaukee than anywhere alse on the Great Lakes.

PRINCIPAL COMMODITIES (INBOUND

Carferry Traffic
Cement
Coal
Agricultural Implements
General Cargo
Grain
Limestone
Liquor and Beer
Motor Vehicles
Newsprint
Petroleum
Pig Iron and Steel
Salt
Sand, Gravel, Crushed Rock
Twine

PRINCIPAL COMMODITIES (OUTBOUND)

Agricultural Machinery
Agricultural Products
- Bulgur
- Corn Meal
- Flour
- Powdered Milk
- Rolled Wheat

General Cargo
Grain
Heavy Machinery
Hides and Skins
Industrial Tractors
Iron and Steel Scrap
Logs and Lumber

Automobiles

Bentonite Clay

Canned Goods

Carferry Traffic

Fats and Oils

White Goods, viz:

Washing Machines,
Refrigerators, Ranges

Source: Port Authority of Milwaukee, 1978.

Principal Commodities Inbound to the Port of Milwaukee

Carferry Traffic
Cement
Coal
Agriculture Implements
General Cargo
Grain
Limestone
Liquor
Beer
Motor Vehicles
Newsprint
Petroleum
Pig Iron
Steel
Salt
Sand
Gravel
Crushed Rock
Twine

A	G	R	I	C	U	I	T	U	R	A	L	C	O	M	P	A	N	E	A
I	M	P	I	E	M	E	N	T	S	R	Q	Y	Z	B	A	B	C	C	B
P	A	C	K	N	C	A	N	A	P	B	C	B	C	A	N	C	M	R	E
L	I	Q	U	O	R	N	W	W	Z	E	N	B	A	I	E	B	D	U	A
T	W	I	N	E	B	C	A	C	B	B	T	B	A	B	A	C	B	S	A
A	C	E	M	E	N	T	Z	W	E	C	A	R	C	C	B	A	C	H	C
B	O	C	B	A	C	A	C	B	A	M	G	B	D	C	B	K	L	E	M
C	A	R	F	E	R	R	Y	B	C	B	E	C	A	L	C	B	K	D	E
P	L	A	C	B	A	B	T	B	C	N	A	N	B	C	E	A	B	R	C
I	B	C	A	M	B	G	R	A	V	E	L	C	T	B	C	U	A	O	B
G	A	C	B	C	B	A	A	B	A	C	B	O	A	C	B	A	M	C	C
I	C	A	S	B	C	A	F	B	C	B	E	E	R	A	B	C	A	K	B
R	A	S	A	A	D	B	F	C	A	L	C	B	A	C	B	A	B	C	C
D	A	Z	L	A	A	B	I	Z	O	N	E	W	S	P	R	I	N	T	Z
N	D	N	T	A	C	P	C	R	E	N	M	C	M	L	K	B	Z	W	Z
B	C	A	O	Z	M	P	T	L	I	M	E	S	T	O	N	E	A	C	N
B	A	C	B	A	G	E	N	E	R	A	L	C	A	R	G	O	Q	M	O
M	O	T	O	R	V	E	H	I	C	L	E	S	B	A	B	C	D	A	B

22

23

24

Principal Commodities outbound from the Port of Milwaukee

Corn
Meal
Flour
Milk
Wheat
Automobiles
Clay
Canned Goods
Fats
Oils
General Cargo
Grain
Heavy Machinery
Hides
Skins
Tractors
Iron
Steel
Logs
Lumber
Refrigerator
Ranges

A	D	A	T	M	E	A	A	L	C	A	R	M	T	O	M	A	O	E	A
U	C	A	R	E	F	R	I	G	E	R	A	T	O	R	S		L	L	P
T	B	F	I	O	U	R	C	A	N	C	B	C	D	F	J	K	U	M	D
O	A	T	M	C	O	R	N	A	C	A	C	C	M	N	P	D	M	N	P
M	Q	N	C	D	N	K	A	J	P	N	N	E	E	P	D	E	B	A	B
D	A	U	S	P	K	E	H	N	A	N	P	E	A	A	E	N	E	B	C
B	B	C	A	S	C	M	E	N	A	E	O	N	L	O	A	C	R	B	A
I	N	M	O	T	P	E	A	N	E	D	O	B	W	H	E	A	T	A	B
L	N	T	R	E	P	A	V	N	O	G	O	O	D	S	N	B	A	D	C
E	O	A	Q	E	R	A	Y	O	K	H	I	D	E	S	B	C	K	J	L
S	S	C	B	L	O	K	M	A	C	H	I	N	E	R	Y	P	L	N	M
A	K	N	F	O	C	I	A	Y	C	G	R	A	I	N	C	M	I	L	K
P	I	B	A	A	B	A	I	R	O	N	B	C	N	B	B	L	C	N	W
Z	N	Z	T	Y	I	M	O	I	L	S	B	A	B	C	B	O	B	C	B
Z	S	Z	S	G	E	N	E	R	A	L	C	A	R	G	O	G	A	A	K
R	A	N	G	E	S	K	T	R	A	C	T	O	R	S	A	S	B	N	A

6. TOUR OF THE MILWAUKEE FILTRATION PLANT

Objective

To aquaint students with the procedures and equipment employed in purifying water taken from Lake Michigan and introducing it into the city's water system.

Activity

Before the tour of the facilities it is best that an explanation of all the operations performed on water from the Lake intake to a faucet in a private home be provided. Then a tour of the filtration plant may be conducted so that students can see many of the operations that have been explained. It can be pointed out that this is recycling of a very valuable resource. In the discussion that follows, the moral aspects of pollution can be discussed.

Contact: Milwaukee Water Works

7. TOUR OF THE MILWAUKEE SEWAGE DISPOSAL PLANT

Objectives

1. To familiarize students with the process of treating waste water produced by a metropolitan area prior to disposal.
2. To reinforce the idea that we re-use our water since there is a finite amount available.
3. To demonstrate what is done with the waste removed from the water.

Activity

The students tour the waste water treatment facility. They can observe the screening process of the raw sewage. An explanation is presented as they view the activate sludge process which ultimately removes 95% of the bacteria content. Finally, the students are shown how the sludge that is removed is converted into a commercial fertilizer called Milorganite.

Contact: Sewage Commissioner, City of Milwaukee
P.O. Box 2079, Milwaukee, WI 53201

8. A VISIT TO THE MARITIME MUSEUM OF SUNKEN TREASURE - PORT WASHINGTON, WISCONSIN

Objectives

1. To inform the students of the many artifacts which have been recovered from the Great Lakes.
2. To develop an appreciation of Port Washington's early cultural setting.
3. To foster student questions regarding the artifacts and the early culture of the area
4. To explore and collect ideas for student projects.

Materials

Forms on which students may record and collect data.

A pencil for each student.

Activity

The students were taken on a field trip to the Port Washington. Upon their arrival at the museum, the students are given a form on which they will indicate their reactions to those aspects of the museum which they find most discouraging, most boring, most complicated, most informative, most understandable, and most alarming. After the forms are completed, they should be collected and held until after the trip when there is time to redistribute them and discuss the student responses.

After the tour, the students can talk with the researchers at the museum about ideas for projects suggested by the artifacts that they saw in the museum. Examples of projects are construction of model ships, knot typing, art work.

Contact: Sunken Treasures Maritime Museum of Port Washington
118 S. Wisconsin Street
Port Washington, WI 53074
(414) 284-3857

NAME_____

DATE_____

AN ANALYSIS OF THE STUDENTS' REACTIONS TO MUSEUM
ARTIFACTS AND PORT WASHINGTON'S EARLY CULTURAL SETTING

Complete the following exercise by filling in the spaces provided below.

1. MOST DISCOURAGING_____
2. MOST BORING_____
3. MOST COMPLICATED_____
4. MOST INFORMATIVE_____
5. MOST UNDERSTANDABLE_____
6. MOST ALARMING_____

In your own opinion, what was the greatest cultural similarity of the area to that of Milwaukee? Why?

9. TOUR OF A SMALL CRAFT SALES AND SERVICE COMPANY

Objective

To introduce the operation of a small craft sales and service company and develop an awareness of career opportunities that exist in this type of business.

Activity

Students may be taken on a tour of the showroom, boat storage area, and repair area by an official of a small craft sales and service company. Students discussed with the guide the operations observed and the careers of the different types of workers

Contact: President, Duchow's Island Yachts, Inc.
1431 S. Carferry Dr.
Milwaukee, WI 53207
(414) 272-1472

10. THE GLACIAL HISTORY OF WISCONSIN

Objective

To illustrate the effect of the Pleistocene Glacial stage on Wisconsin and the creation of the Great Lakes.

Materials

Film "Great Lakes: How They Were Formed" 12 minutes,Grubbs #57 in Educators Guide to Great Lakes Materials

Film Projector

Activities

Students viewed the film and there was discussion and presentation of glacial terminology and occurence of glacial features in southeastern Wisconsin. Students could observe eskers, kames, drumlins, kettles and moraines on the trip to Port Washington and Saukville which was taken for other purposes.

Ancient shorelines of Lake Michigan can be seen as present day bluffs above our beaches. This is due to the rising of the land, "rebounding," from the pressure of the glacier which varied in thickness from one to two miles.

11. A STUDY OF THE LAKE MICHIGAN BASIN

Objective

1. To teach the general structure of Lake Michigan through construction of a four by eight foot relief map of the lake.
2. To develop the concepts of contour map and contour line.
3. To familiarize students with the general location of deeper portions of the lake.
4. To enable students to learn to work cooperatively and carefully in tracing, cutting, painting, and assembling the relief map.

Materials

Bathometric Maps of Lake Michigan

plywood, 1/4" x 4' x 8'

corrugated cardboard, 25 sheets (large approx. 50" x 40")

poster paint, blue, powdered, 2 lb.

poster paint, white, powdered, 2 lb.

poster paint, brown, powdered, 2 lb.

poster paint, green, powdered, 2 lb.

scalpels or matting knives

knife sharpener

24 paint brushes

2 qts. rubber cement

contour maps

Activity

Students are divided into groups of 2 or 3. Each group cuts along contour lines on the bathometric maps. These lines show differences in depth of the lake of 50 meters. The lines used show depths of 0, 50, 100, 200 and 250 meters. The figures obtained by cutting up the maps are traced on the corrugated cardboard. The cardboard is then cut along these lines. The result is a number of "lakes" each 50 meters deeper than the other. The pieces of cardboard representing different depths are painted shades of blue with the deepest portion of the lake being the darkest. They are then piled on top of each other with the piece representing the shoreline on the bottom and the deepest part on top of each other resulting in an inverse relief of the basin. The land area surrounding the lake represented by the exposed cardboard is painted various shades of brown and green.

An alternative approach is to pile up the large pieces of cardboard from which the holes have been cut. The piece with the smallest hole, representing the deepest portion, would be on the bottom and that with the largest hole, representing the shoreline, would be on top.

Contact: For purchase of bathometric maps
University of Wisconsin-Milwaukee
Center for Great Lakes Studies
Milwaukee, WI 53201

2. OFF SHORE OIL

Objectives

1. To introduce students to the ways in which oil appears to have been formed and the equipment and procedures employed by scientists in searching for oil
2. To describe the geologic formation under Lake Michigan
3. To consider the possibility of oil existing under Lake Michigan.

Films

1. Ekofisk: City at Sea
2. Pennzoil Off Shore

Available from: Modern Talking Picture Service
2323 New Hyde Park Road
New Hyde Park, New York 11040

Activity

Students view films dealing with the off-shore search for oil. Following the films, discussion can center around the possibility of locating oil in Lake Michigan. Natural asphalt sepages in the area are discussed along with the geologic formations. This is related to the location of oil. Political and economic entanglements concerning oil located in boundary waters are also discussed.

13. INTERPRETIVE GREAT LAKES BASIN PRESENTATION

Objective

To develop an awareness of the processes of the formation of the Great Lakes Basin through interpretive dance and movements concerning the glacier's trail and deglaciation.

Equipment

Record player and recording of "Ship Ahoy."

Activity

This activity consists of a five minute interpretive dance prepared by a dance instructor followed by a question and answer period in which the students discuss the meaning of the dance. Factual material regarding Wisconsin's last ice age and its effect on the formation of Lake Michigan are presented to the students. This activity can be used to lead directly into the building of the relief map of the Lake Michigan Basin by students.

14. A STUDY OF THE GREAT LAKES AND THEIR PORT CITIES

Objective

To develop an understanding of the complexity and the magnitude of the Great Lakes as a commercial and geographic entity.

Materials

Corrugated cardboard, sheets (large, approx. 50" x 40")

Poster Paint, blue powdered

Poster Paint, brown powdered

Poster Paint, red powdered

Transparencies

Poster Paint, green powdered

Matting knives

Brushes

Activity

The students should be divided into groups of 4 or 5 for this activity. The students in each group first view a transparency of the Great Lakes and their port cities. While viewing the transparency, they trace the Great Lakes on the cardboard. Each lake is then colored blue. After tracing and coloring the Great Lakes, the students are to write the names of the lakes in their proper places in shades of brown. The students then locate the major port cities by making small red dots. The names of these port cities are written in their specific locations. The

depth, width, and length of each lake can be indicated along the borders of the Great Lakes, in shades of green. As a finishing touch, the students should color the land surround the lakes in shades of brown. A legend is then placed at the bottom of the map.

15. DISCUSSION OF LAKE POLLUTION

Conducted by representatives of the Wisconsin Electric Power Company, the Wisconsin Department of Natural Resources, and University of Wisconsin scientists.

Objectives

1. To aquaint the students with the major types and sources of pollution of the Great Lakes.
2. To demonstrate, through an example, how findings from research lead to regulations enforced by governmental agencies which must be complied with by industry. Research dealing with the effect of chlorine on fish was used as the example here.

Activities

The students should be divided into 3 groups and rotated through the three following presentations

1. DNR representatives describe their major role as that of maintaining the quality of Lake Michigan and enhancing it. They explain their fish management programs and pollution monitoring and abatement programs.
2. A researcher explains the work being done with the effects of various chlorine levels on fish and demonstrates certain techniques. An explanation can be given on how this work may eventually lead to a new regulation.
3. The representative from the Electric Power Company will discuss the different types of pollution with emphasis on water

pollution. Particular attention should be paid to chlorine since it is used to clean out the condensers of nuclear power plants.

Contact:

(1) Wisconsin Electric Power Co.
231 W. Michigan Street
Milwaukee, WI
(414) 277-2345

(2) Wisconsin Department of Natural Resources
District Headquarters
9722 Watertown Plank Road
Milwaukee, WI 53226
(414) 257-6511

(3) For UW Marine scientists contact:
Dr. James Lubner
UW Sea Grant Advisory Services
600 E. Greenfield Ave.
Milwaukee, WI
(414) 963-5846

16. HEAT CAPACITY AND CLIMATE

Objectives

1. To enable students to describe the climate of a coastal city and the ways in which the lake may effect it.
2. To introduce the concept of heat capacity of water and its relation to that of other materials

Materials

6 pie tins

water

5 different sands and soils (i.e., light and dark)

6 thermometers

Activity

Students set up the six pie tins, each filled with equal masses of different materials (water, sand, crushed rock, dark soil, etc.). Initial temperatures are taken (all should be approximately the same) and recorded. The tins are placed in direct sunlight and temperatures of each are to be recorded at one minute intervals. After approximately ten minutes the pans should be removed from the sunlight and the temperatures recorded at one minute intervals for about 10 minutes as the materials cool. The students will observe that the water heats up the slowest and cools down the slowest.

With the aid of pictures and diagrams this principle can then be related to a large body of water such as Lake Michigan to show how it modifies the climate in the Shoreline areas.

17. SAILING

Objectives

1. To develop an interest in recreational boating on the Great Lakes
2. To introduce the skills needed to operate a sailboat on Lake Michigan.

Activity

Volunteer owners of several sailboats assemble at the marina. Students accompanied by instructors are divided according to the capacity of the boats. During the two-hour sailing period, students are permitted to engage in the operation of the boats as fully as possible.

Contact:

(1) Milwaukee Yacht Club
1700 N. Lincoln Memorial Drive
Milwaukee, WI 53202
(414) 271-8105

(2) University of Wisconsin-Milwaukee
Sailing Club
Student Union
Milwaukee, Wisconsin 53201

(3) Milwaukee Community Sailing Center
610 N. Jackson YWCA
(414) 271-1030

18. ON-SHORE FISHING

Objectives

1. To develop an awareness of the different types of fishing equipment that can be used on the Great Lakes.
2. To introduce the skills needed for spincasting from the breakwater of Lake Michigan.

Materials

Spin-casting rods, reels, and lures

Life jackets

Activities

1. A slide presentation and narration by a skilled on-shore fisherman is used to introduce the different types of fishing equipment. In addition, boats used for off-shore fishing can be described along with related topics such as weather changes and the need for preparedness.
2. Skills and equipment needed for casting, spin-casting, spinning and ultra-light spinning reels are then demonstrated.
3. Students are then given an opportunity to spin-cast from shore for one to two hours with the guidance of instructors.

Contact:

Dr. James Lubner
Sea Grant Advisory Services
600 E. Greenfield Ave.
Milwaukee, WI 53204
(414) 963-5847

19. FISH ANATOMY AND COOKERY

Objectives

1. To introduce the skills required for the use of gill nets.
2. To identify various species of fish
3. To identify various organs of fish
4. To teach fundamental skills in filleting various species of fish

Material

Gill Nets

Activity 1

A demonstration using some of the larger Lake Trout and Salmonoids is used in the introduction. With the dissection and examination of these larger species, it is easy to locate and identify various important organs and discuss their physiological functions.

Activity II

The students can be given the opportunity to see how a researcher gathers various species of fish using an experimental gill net. The nets must have been set by the researchers the previous day. The gill nets are gathered and brought back to the facility where the students can be shown how to remove the fish from the gill nets and how to care for the nets. The researcher than discusses each type of fish collected. An explanation is given of how the fish collected are to be utilized by the

researcher. Basic statistical information concerning size, age, and weight are collected from each specimen. This should be followed by an explanation and demonstration of the external and internal anatomy of fish. Later, the students should have the opportunity to dissect "rough" or underutilized fish in a laboratory investigation.

Activity III

The students view a film on fish filleting. The process is then demonstrated by an instructor. The students then practice the techniques again employing underutilized fish.

Contact:

Dr. James Lubner
Sea Grant Advisory Services
600 E. Greenfield Ave.
Milwaukee, WI
(414) 963-5846

Mr. Fred Binkowski
Department of Zoology
University of Wisconsin-Milwaukee
Milwaukee, WI 53201
(414) 963-4214

20, TOUR OF THE JOHN G. SHEDD AQUARIUM

Objective

To introduce students to the facilities of the Shedd Aquarium in Chicago in which displays of both salt and fresh-water fish are located. The activity is designed to extend the experiences introduced through the studies of the Milwaukee River and Lake Michigan.

Activity

This is an all day field trip from Milwaukee. Students are given a brief orientation to the facilities before touring them under the guidance of the summer program instructors. Other additional activities can be provided by museum personnel.

Contact:

Assistant Curator for Education
John G. Shedd Aquarium
1200 S. Lake Shore Drive
Chicago, Ill. 60605

21. FISH OF THE GREAT LAKES AND INLAND WATERS

Objectives

1. To introduce students to the major fish species in southeastern Wisconsin, their respective habitats, and their tolerance of various pollutants
2. To enable students to identify the major fish species found in the Great Lakes and to describe their respective habitats.
3. To enable students to describe the historical development of the current status of fish in the Great Lakes including the introduction to exotic species.

Activities

A fish scientist can be invited from some agency such as the Milwaukee Public Museum or the University of Wisconsin Department of Zoology to conduct a lecture discussion illustrated with slides.

Contact:

Dr. James F. Lubner
Field Agent
University of Wisconsin Sea Grant College Program
Great Lakes Research Facility
600 E. Greenfield Ave.
Milwaukee, WI 53204

22. MARINE ART WORK

Objective

To enable students to express themselves concerning the marine environment through silk screening, drawing and painting.

Materials

Silk screen kits

Supplies for drawing and painting

Activities

The following activities provide art experiences for those students wishing to participate in them.

1. Students can create a design for the cover of their notebooks and their tee shirts and use a silk screen to do the printing.
2. Students can sit near the dock and make drawings and paintings of the various harbor scenes.

Symbols on tee shirts used to enhance group cohesiveness.

23. CAREERS IN THE U.S. COAST GUARD

Objective

To develop an interest in the activities and facilities of the U.S. Coast Guard in Milwaukee.

Activity

Students are taken on a tour of the Milwaukee Coast Guard Facility by a petty officer who explains the responsibilities and functions of the Coast Guard, and the operations of the boats. Students also have an opportunity to observe the boats used by the Coast Guard and those used by the Sea Scouts.

Contact:

U.S. Coast Guard
2420 S. Lincoln Memorial Drive
Milwaukee, WI 53207
(414) 291-3165

24. STUDYING A RIVER

Objectives

1. To show how a river changes character as it flows from an agricultural environment to an urban environment.
2. To introduce skills and equipment used in obtaining samples of water and organisms in a river.
3. To examine relationships between aquatic life and its physical environment.
4. To introduce the use of a dichotomous key for identifying common organisms found in a river.

Materials

Hach kits for determining PO_4, NO_3, and D.O.

Chest waders

Ponar grab

Sienes

Plastic buckets with screen covers

Plastic specimen bags

B.O.D. bottles (biological oxygen demand)

Life jackets for all persons in the water or near its edge at any one time

Identification text of fundamental fresh water aquatic life

Inductory key to fresh water macroinvertebrates and vertebrates

Introductory plant key

pH paper (4.5 - 7.8) or pH meter

Activities

In this study students examine a river such as the Milwaukee River at various sites from near its origin in a rural setting to its mouth in the harbor of a city. Differences in all facets of the river environment can be examined and changes from one location to another noted. Specimens of water and living things can be collected and taken to a laboratory for examination. Instructors will have to demonstrate the correct and safe use of all equipment. The following activities can be carried out:

1. Seines can be used to collect small animals such as minnows, crayfish, snails, turtles, and frogs. These should be kept alive through proper care.
2. Specimens of plant life can be collected at the various sites. These should be labeled so that they can be studied in relation to their natural settings even when they have been taken to the laboratory.
3. Use the ponar grab to collect bottom samples at each of the sites.
4. Specimens of water can be collected at each site and labeled for analysis in the laboratory.

25. A TREASURE CHEST OF SCIENTIFIC INVESTIGATIONS OF FRESH WATER ENVIRONMENTS

These are follow up activities for a field study of a river or other fresh water environment. They provide for individualization since it is likely that students will differ in their interests concerning various aspects of the environments studied.

Student directions for the following activities are included in the Treasure Chest.

A. Studying materials dissolved in water

B. Setting up a miniecosystem

C. The compound microscope

D. The tolerance for survival of brine shrimp

E. Examination of Fresh water algae or plankton

F. The comparative color block indicator

G. The effect of temperature on the breathing process of goldfish

A. STUDYING MATERIALS DISSOLVED IN WATER

1. Determination of dissolved oxygen. Finding out how much oxygen is dissolved in water is an important test in determining the quality of wmter. Generally speaking, the better the water quality the more oxygen can be dissolved in it. The amount that can be dissolved in any body of wmter is affected by such factors as temperature, depth, turbulence, light, biological activity and sludge deposits. The amount of dissolved oxygen (D.O.) present is measured in milligrams per liter (mg/l). For this purpose water is collected in the B.O.D. bottles at various sites and the Hach kit is used according to the directions provided with it.

   Animals depend upon oxygen to live. The amount of oxygen present in the water will determine to a great extent what animals will live there. A D.O. of 4 to 5 mg/l is marginal for supporting aquatic life. Game fish require 8 to 15 mg/l of dissolved oxygen.

   You will use a Hach water test kit to determine the amount of dissolved oxygen (D.O.) in your sample.

2. Determination of dissolved PO_4.

Phosphates (PO_4) are present in all water but the levels of the substances depend on the area from which the water sample is taken. High levels of phosphates indicate a high degree of organic pollution and would be expected in agricultural areas and in areas where sewage goes untreated. The instructors will demonstrate how to analyze water for PO . You will determine how much PO_4 is in your water sample and record the value on the data sheet.

3. Determination of dissolved NO_3.

Nitrogen is necessary for all organisms. Nitrates contain nitrogen in a usable form. Again the instructors will demonstrate the use of the Hach Kit in NO_3 determinations. You will then analyze your own water samples and record the value on the data sheet.

4. Determine the temperature of the water at each of the sampling areas. Record these on the data sheet.
5. Determine the pH of the water at each of the sampling areas. Record these on the data sheet.
6. Use the plant and animal keys to identify organisms observed at each of the sites and again back in the laboratory with the specimens that have been collected.
7. After comparing the data gathered at the various river sites answer the following questions:
    a. Where is the highest concentration of dissolved PO_4
    b. How can this be explained?
    c. Where is the highest concentration of dissolved NO_3?
    d. How can this be explained?
    e. Where is the most dissolved oxygen available?
    f. What can we infer from this information about the amount of life at these different locations?
8. With the help of your instructor and by using all of the information you have gathered about the river develop a general land use map for the river.

B. SETTING UP A "MINI" ECOSYSTEM

Objectives

To study the interrelations between organisms and their physical and biotic environments; to find out what effect the variations of tolerances have on the diversity and distribution of organisms.

Materiale and Equipment

Water from the lake or river

Organisms obtained by seining the river or lake

Wide mouth jars or small aquaria

Procedures

Take the water and organisms you obtained from the river or lake and fill your jars or aquaria about 1/2 full. Make a list of things you observe in your mini ecosystem. How many populations are represented? Keep a record of the plant and animal relationships you observe. Are there changes in the system from day to day?

Put a list of your observations on the data sheet i.e., temperature, pH, D.O., CO_2, etc. Refer to the Hach Kits for instructions for making the various tests.

C. THE COMPOUND MICROSCOPE

Information

The microscope allows one to see things that are too small to be seen with the naked eye. The sooner you become aware of the parts and uses of them, the sooner your knowledge of the microscope world is enhanced. The marine biologist uses a microscope to see the organisms that live in water.

Objective

To allow you to become familiar with the microscope and its operation.

Materials

Microscope, slides, cover glasses, dropper, water, newspaper

Procedures

Carefully place the microscope on the table up-right. Use the lower power lense. Adjust the mirror for maximum light while looking through the eyepiece using the large opening of the diaphragm. Add a few drops of water with brine shrimp eggs and cover with a cover glass. Place the slide on the stage for viewing. Lower the body tube with the coarse adjustment. Find the image of the object and finish focusing with the fine adjustment. Remember, do not use high power.

The object you have on the slide does not move, unlike a number of the microscopic organisms you are going to find in the water samples you

will study. So be sure to use the microscope each day in order to improve your skills. See the diagram of a microscope in one of the biology books for names of the various parts if needed.

D. THE TOLERANCE FOR SURVIVAL OF BRINE SHRIMP

Objective

To become familiar with the patterns in nature which determine survival factors for an organism.

Materials

Brine shrimp (100), plastic cups (5), salt water solution.

Procedures

There are patterns in nature which you can observe. Using five plastic cups, label them 0%, 0.1%, 1%, 5%, and 10.0%. Put 20 ml of the proper stock solution into each cup. Shake well before using. Add brine shrimp eggs to each. Examine the cups each day and count the number that has hatched during your stay in program. Complete the sample chart below.

SOLUTIONS	0%	0.1%	1%	5%	10%
DAYS 1					
2					
3					
4					

NUMBERS

The stock solutions are prepared by mixing salt (naCl) to distilled water. The percentages represent the mmount by weight of salt in the final solution. Thus a 5% solution of salt is made by adding 50 grams of salt to 95 grams of water.

E. EXAMINATION OF FRESH-WATER ALGAE OR PLANKTON

Information

The concentration of certain kinds of algae in an area is dependent upon the environment. The amount of silicon present determines the number of diatoms. The kind of algae present is based upon the degree of acidity of the water. Algae are indentified by the arrangement of the cells in colonies, size and shape of cells, form of chloroplast, filaments, and locomotive organells.

Objective

To become familiar with the diversity of the plankton associated with the samples from the Milwaukee River and Lake Michigan.

Materials and equipment

Microscope, slides, cover glasses, buckets, bottles, thermometer, droppers, aquarium, centrifuge, plankton net.

Procedures

Collect several samples of water from the Milwaukee River and Lake Michigan habitats using buckets and jars. Record as many physical features as possible, such as temperature, depth of water, movement of the stream, is the area shaded or sunny, sewer pipes, etc. When storing the samples in the lab, be sure to label the tanks. When taking samples, use the plankton nets and pour several buckets through the net. Then

take the small bottle and place some of the sample in test tubes to be centrifuged. Afterwards, prepare a slide and fill in the sample chart below. Consult an identification chart of fresh-water algae in one of the biology manuals when necessary.

Pertinent Information	Specimen Number							
	1	2	3	4	5	6	7	8
Location								
Nature of habitast (rapids quiet)								
Condition of water								
Depth of water								
Temperature of water								
Stationary or free floating								
Cell organization								
Color of specimen								
Shape of Chloroplast								

F. THE COMPARATIVE COLOR BLOCK INDICATOR

Objective

To become aware of different methods for measuring pH.

Information

In addition to hydrion paper and universal indicators, the Comparative Color Block Indicator is another method for determing pH. Standard differently colored test tubes are provided. Each color represents a specific pH. If a substance matches the color of one of the standards, after an indicator has been added, then it has the same pH as the standard.

Materials and Equipment

Comparative Color Block Indicator, (kit) lemon juice, vinegar, milk, HCL, baking soda, lake water, river water.

Procedure

Fill the blank tube with test substance up to the gradation line. Add 5 drops of standard solution. Mix gently. Place lemon juice or substance in slot of block. Hold up to light and choose standard that seems to match mixture. Record the pH of the matching tube. Using these procedures, complete the chart for all substances. Wear safety goggles in this activity.

SUBSTANCE	pH
LEMON JUICE	
BAKING SODA	
VINEGAR	
MILK	
HCL	
LAKE WATER	
RIVER WATER	

G. THE EFFECT OF TEMPERATURE ON THE BREATHING PROCESSES OF GOLDFISH

Information

Goldfish live in fresh water. They eat small plants and insects. In an aquarium they like to eat water fleas and ant's eggs. A goldfish can take a mouthful of mud and sort out the plant and animal material. Oxygen is soluble in water. The oxygen diffuses into the fishes blood by way of the gills. You can observe this process by watching the gill flap. Carbon dioxide is expelled from the blood in this process.

Objective

To observe the effect of temperature on goldfish breathing.

Materials and equipment

Large jar, goldfish, ice water, watch, thermometer.

Procedures

Locate the gill flaps and observe the goldfish breathe. Count the number of times the gill flaps open in one minute and record the temperature. Wait 4 minutes and add 1 cube of ice and repeat the above procedure. When the temperature of the water does not change, stop and plot a graph of the number of gill flap movements vs. temperature.

H. DATA COLLECTED WHILE ON THE RESEARCH VESSEL

Stops #1, 2, 3, etc.

A Direction of Vessel_____

B Activity

1 Plankton_____

2 Ponar Grab_____

3 Dissolved oxygen_____

4 Phleger Core_____

5 Secchi Disc Drop_____

6 Surface and BT Temperature Reading_____

7 Van Dorn Sample_____

8 Nanson Sample_____

C Record the following Data

1 Depth of Van Dorn Sample_____

2 Temperatures_____

3 Depth of Secchi Disc_____

4 Depth of Ponar Grab_____

5 Complete the ships log_____

6 BT Readings

1m 2m 3m 4m 5m 6m 7m 8m 9m 10m 11m 12m 13m

26. USE OF A RESEARCH VESSEL

See Appendix A The Log of the Aquarius, for Student Directions

Objectives

A. Instruction Prior to Shipboard Activities:

1. To familiarize the student with the scientific equipment that is to be used aboard the research vessel.
2. To facilitate any explanation of the equipment aboard the vessel as ship time is at a premium.
3. To facilitate movement through experiments aboard the research vessel.

B. Activities Aboard Ship:

1. To develop an awareness of microlife in Lake Michigan water and bottom sediments.
2. To practice skills required for the use of data collecting instruments.
3. To introduce knowledge and skills required for examining and preserving specimens obtained from the lake.

C. Follow-up of Shipboard Activities

1. To examine the specimens and other data gathered while on the research vessel.
2. To introduce skills required for the use of microscopes and stero-microscopes.
3. To learn the skills needed for the temporary and permanent preparation of microscopic slides

4. To identify existing micro-organisms (phytoplankton and zooplankton) in Lake Michigan.
5. To help students see relationships between data collected and general fish behavior.

Materials

Activity A & B

Dissolved Oxygen Kit

Phleger core (desirable but depends upon geologic background of the staff)

Plankton Net

Ponar Grab

Secchi Disc

Van Dorn or Nanson Bottle

Whitney Thermometer; Bathythermograph

Polyvinyl lactophenol

Lignin pink

Activity C

Microscopes

Stereomicroscopes

Glass microscope Slides

Glass coverslips (22mm x 22mm)

Petri dishes

Eye droppers

Specimens and data from previous day's trip

Identification text of fundamental fresh water aquatic life

Clear fingernail polish

Activities

A. Prior to the shipboard activities

A thorough explanation and demonstration of each piece of scientific equipment to be used aboard the research vessel should be given. Students should have the opportunity to practice the operation of this equipment wherever possible. The suggested equipment includes:

Secchi Disc

Whitney Thermometer, Bathythermograph

Dissolved Oxygen Test

Plankton Net

Ponar Grab

Van Dorn or Nanson Bottle

B. Aboard Ship

Complete directions for this activity are provided in the Log of the Aquarius which appears in the Appendix. Copies of the log are distributed to each of the students. Data are collected between one and two miles outside the Milwaukee breakwater. One complete round-trip will require approximately an hour and a half.

C. Follow-up Activities

1. Identification of some of the phytoplankton and zooplankton captured during the vertical plankton haul.

2. Indentification of some of the larger crutaceans, Brachiopods, and nematodes found while using the Ponar Grab.
3. After preliminary identification, the student can make a permanent slide using polyvinyl lactophenol, and lignin pink.
4. Illustrated demonstrations and discussion of principles related to the thermocline (utilizing information gathered with the Whitney thermometer).
5. Discussion of background information on dissolved oxygen and its effect on the biotic life and its relation to the thermocline.
6. Interpretation of the data derived from the use of the Secchi disc.
7. Interpretation of the core samples.
8. Staining of invertebrate specimens for microscopic examination using these directions:

Material: glass slide, glass cover slip, Polyvinl Lactophenol, Lignin pink, clear fingernail polish

Preparation of stain and fixitive: To 25 ml. of polyvinyl lactophenol, add and stir a sufficient amount of lignin pink to obtain a dark pink, viscous fluid. This will require about .1 g or less. This solution can be lightened by adding polyvinyl lactophenol or darkened by adding lignin pink as necessary.

Preparation of slide: a) Place specimen in the center of the slide with a small drop of water

b) Add 2 drops of staining solution--portions of the solution may cloud up upon contact with the water. This will clear.

c) Place a cover slip over this and allow solution to migrate to all edges of the cover slip.

d) Seal the edges of the cover slip with clear fingernail polish.

Arranging the Activity

The research vessels used in the tryout of this Activity were the Aquarius and the Neesksy and were provided by the University of Wisconsin Sea Grant College Program. The Aquarius could accomodate ten persons at a time while the Neesksy could accommodate fifteen. The cost of these vessels was $300 and $500 per day, respectively. Other vessels could be used as long as they are equipped with a boom and winch for lowering the equipment over the side and are operated by qualified personnel.

Contact:

Dr. James F. Lubner, University of Wisconsin Sea Grant
Field Agent
600 East Greenfield Avenue
Milwaukee, Wisconsin 53204

- for current information concerning the availability of research vessels.

Additional Activity

In addition to or in lieu of the actual collection of data aboard a research vessel, it may often be possible to take a tour of a research vessel if one happens to be docked at the University of Wisconsin Great Lakes Research Facility. The features of these vessels often include the equipment on deck for lowering the instrument into the water, laboratories for microbiology and radioactvivity studies, the pilot house, engine room galley and mess hall and living quarters for the crew and researchers.

27. NAVIGATION

Objectives

1. To introduce the fundamental techniques used in plotting navigational courses on large bodies of water.
2. To introduce navigational tools and the skills required for their use.

Materials

dividers

nautical parallel rules

navigational slide rule and computer

Activity

Directions for this activity are included in the Log of the Log of the Aquarius since this activity can be done by students while on the research vessel. If this is not possible it may be done on shore.

The students should be divided into small groups of about 10. Each piece of equipment should first be explained and demonstrated. Students can then solve the problems on the worksheet with the instructor giving as much help as mecessary. It is suggested that the first problems be worked by the instructor before the entire class.

Arranging the Activity

The Nautical maps are available through the National Oceanic and Atmospheric Administration (NCAA), National Ocean Survey. There are maps available through the Milwaukee Map Service: 4519 W. North Avenue, Milwaukee, Wisconsin 53208, telephone: 445-7361.

Or: Distribution Division (C44), National Ocean Survey; Riverdale, Maryland, 20840, telephone: 301-436-6990.

APPENDIX A

LOG OF THE AQUARIUS

This log was used by the participants aboard the research vessel Aquarius. It was distributed to the students prior to departure. The students utilized it as a source of information and as a laboratory manual.

the log of the aquarius

SEA GRANT STUDENT EDUCATIONAL PROGRAM
GREAT LAKES RESEARCH CENTER
MILWAUKEE, WISCONSIN

WRITTEN BY:

Beth Sieckman
Donald Shebesta
Scott Temperly

ART WORK BY:

Irene Hoffman

Student Name: _____

Summer, 1977

Welcome Aboard!

The Aquarius is a Great Lakes research vessel. We hope your visit will be exciting and rewarding and perhaps encourage you to look further into careers related to the study of the sea which is called -- oceanography.

We would also hope that the knowledge you gain today will give you a better understanding of the world in which you live so as to be a well informed citizen.

Aboard the Aquarius you will use instruments and equipment designed by researchers to answer questions such as these: What are the physical and chemical properties of the lakes' waters? What is the structure of the lake basin? What are the life forms found within this basin?

We pipe you aboard with all the ceremony of an admiral. Enjoy your cruise.

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THE WATERY PLANT ----

Pictures of earth taken from deep space show earth as a beautiful, blue colored planet with occasional chunks of brown, and brushed with white swirls of clouds. As you might guess, the blue is water; the brown, continents, and the white, the cloud filled atmosphere that cacoons earth.

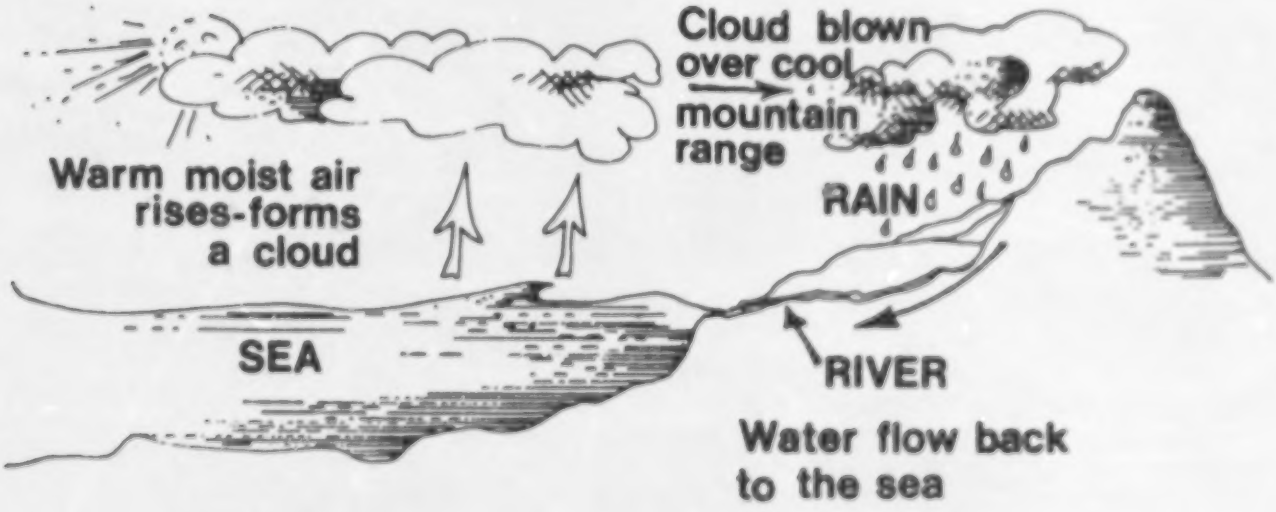
Of all the 9 planets, earth is unique for it is the only planet known to have extensive water on its surface. In fact, 71% of the earth's surface is covered with water both fresh and marine (sea water). Without this water, earth would be without life as we know it.

WHAT IS THE ORIGIN OF THIS WATER ----

Most scientists are agreed that throughout two thirds of earth's 4 1/2 to 6 billion year history she was a molten mass gradually cooling. Gasses rising from the molten rock (lava) contained water. As these watery gasses cooled, they fell back to earth as rain only to be hissed back into the atmosphere as steam when they touched the hot earth.

Gradually earth cooled enough to permit the water to collect in pockets that, in time, filled the low areas to become seas.

All the water existing on earth today is basically all the earth shall ever have. Only a minor amount of "new" water is given to the earth from hot springs whose waters originate deep within the crust and volcanic eruptions. The water we have on earth is used and reused over and over again. The water that some Egyptian pharoah took a bath in is used today to water your garden. But how can this happen?



HYDROLOGIC CYCLE ----

The answer lies in a term called the hydrologic cycle -- a circling pattern of water. Look at the drawing above and you can quickly see the continual recycling of water -- the reuse of water.

A sudden cloudburst may pour thousands of gallons of water onto the land. Some water will reach the sea by way of rivers and streams and surface run-off. Other waters will seep into the land to nourish plant life. Over a long period of time these waters will reach the sea via underground rivers. Once the waters have returned to the sea, the warm sun causes evaporation and the cycle begins again.

OCEAN AND LAKE BASINS ----

The giant kettles which hold the earth's water on its surface are called basins. Though earth's ocean basins were believed formed when an original single continent began to split apart some 300 million years ago; earth's Great Lakes basins were generally formed by great sheets of ice that had their origin in the Canadian highlands near Hudson Bay.

Lake Michigan, in particular, was once a small river. A two mile high sheet of ice seeking a path of least resistance followed that river course bulldozing the path deeper and wider than the original river.

When warmer weather caused the ice to retreat, the melting ice filled the basin and Lake Michigan was formed.

YOUR LAKE -- AN AIR CONDITIONER; A HOT WATER BOTTLE ----

Your lake has a great affect on Milwaukee's weather; in fact, its presence makes Milwaukee's weather very difficult to forecast. Why?

Water has an important physical characteristic called -- heat capacity. Simply stated, it means that water does not change its temperature easily. In the summer, the lake gradually warms with the heat of the summer sun. It is a slow process for you need only think of swimming in the lake in June as opposed to a swim in late August. The lake is the warmest it will become in late October.

As winter approaches, the lake gradually cools, giving its heat to warm Milwaukee in the winter. As you would guess, the slowly cooled Lake Michigan waters keep Milwaukee cool during the summer.

FEATURES OF LAKE MICHIGAN ---

AGE -- The melting of the retreating glaciers left a teardrop shaped lake called Lake Michigan approximately 6000 years ago.

RELATIVES -- The four other great lakes are her sisters; Superior, the largest; Lake Huron, the second largest; Erie, and Ontario.

SIZE -- So great is the size of the inland lakes that they have been called North America's inland oceans. They cover 95,000 square miles and together hold more fresh water than any other similar bodies in the world.

The lakes themselves not only look like oceans but they behave like oceans affecting weather, containing internal waves, containing abundant life, and having many common geological features.

Though we treat Lake Michigan separately in our study, it is important to remember that the Great Lakes are closely related -- each has an effect upon the other.

FACTS AND FIGURES ----

Lake Michigan is the third largest of the Great Lakes.

Her average depth is 85 meters or 276 feet.

Her greatest depth is 281.3 meters or 914 feet.

She is 176 meters above sea level - (572 feet)

LOCATION ----

Lake Michigan dangles like a huge teardrop between the two larger lakes: Huron and Superior. However, it is the only Great Lake entirely within the boarders of the United States.

IMPORTANCE ----

Lake Michigan has more recreational shoreland than any other United States portion of the Great Lakes.

Over thirteen million people live around the lake putting tremendous use on its waters and shoreline making it subject to great pollution.

HISTORY ----

The French in 1535 following the St. Lawrence routes of the little known Norwegien explorers, were convinced that by sailing the Great Lakes they could reach the Orient. When China remained elusive, the resourceful French under the leadership of men like Jean Nicolet (1634; Joliet (1673), and Father Marquette sought the riches of the area in fur and minerals.

Other men like explorers La Salle, Hennepin, and Duluth approached the lake from its southern end.

In time, missionaries and fur traders were followed by loggers, miners and farmers.

PROBLEMS ----

Lake Michigan is one of the most endangered of the five lakes if you declare Lake Erie as a major disaster due to man's pollution. Unlike Lake Erie that replaces its entire water supply in two and 1/2 years, Lake Michigan takes 100 years. The tremendous number of cities with their millions of people, vast agriculture, industrial and commercial use has already closed many Wisconsin swimming beaches, destroyed fishing and left great areas of shoreline unsightly. The general decline of Lake Michigan must be a major concern for all Americans and especially those Americans bordering the lake.

LIFE IN LAKE MICHIGAN ----

The life contained within Lake Michigan has a great size range. Tiny floating plans called phytoplankton of which diatoms are the most common examples are the smallest. Microscopic animals called zooplankton are the smallest animals. Scientists group these microscopic life forms under the general term - plankton. Animal life ranges in size from the tiny zooplankton to the four inch alewife, to Great Lakes Trout and Coho Salmon.

Station 1
Dissolved Oxygen (D.O.)

Finding out how much oxygen is dissolved in the water is an important test in determining the quality of water. Generally speaking, the better the water quality the more oxygen can be dissolved in it. The amount of oxygen that can be dissolved in any body of water by other factors is effected by temperature, depth, turbulence, light, biological activity and sludge deposits.

The amount of dissolved oxygen (D.O.) present in water is measured in milligrams per liter (mg./l.). The method you will use to determine the D.O. will be explained later.

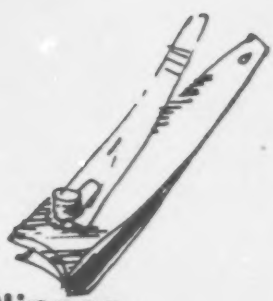
Animals depend upon oxygen to live. The amount of oxygen present in the water will determine to a great extent what animals will live there. Gamefish require 8-15 mg./l. of dissolved oxygen to live. A D.O. of 4-5 mg./l. is marginal for supporting aquatic life.

You will use a Mach water test kit to determine the amount of dissolved oxygen (D.O.) in your sample. This kit contains chemicals for several tests. Morever, you will only use those chemicals in the right hand side of the kit.

Your water samples will be collected from 3 depths; near the surface, at about midpoint, and hear the bottom. Each group will test only one sample. Share your results with other members working on other samples.

Dissolved Oxygen Bottle

Pillow



Clipper

Procedure

1. Fill the glass-stoppered D.O. bottle with your water sample until it overflows. Be sure no air bubbles are trapped in the bottle.

2. Open the square plastic jar labeled Dissolved Oxygen 1 Reagent Powder. Remove one pillow. Open the pillow using the clipper provided. Add the powder to the D.O. bottle. Repeat this with the Dissolved Oxygen 2 Reagent Powder.

3. Stopper the DO. bottle. Do not worry about any water that overflows. It is important that no air bubbles remain in the bottle. If some air bubbles remain in the bottle, throw your sample away and start over.

4. Hold the D.O. bottle and stopper together firmly and shake well. You will see water sample turn brownish in color and cloudy.

5. Set the sample down and allow the cloudiness (precipitate) to settle down to about the half way mark (the white line on the bottle). Shake the bottle again and allow the precipitate to settle again.

6. Open the large round jar labeled Dissolved Oxygen 3 Reagent Powder. Remove one pillow.

7. Remove the stopper from the D.O. bottle. Clip open the pillow and add the Dissolved Oxygen 3 Reagent Powder.

8. Re-stopper the D.O. bottle and mix well. The precipitate will dissolve and a yellow color will appear if oxygen is present. This solution is your prepared sample.

9. Fill the plastic measuring tube to the very top with the prepared sample. Pour this measured sample into the mixing bottle.

10. Locate the PAD Titrant in your kit. This should be in the bottom row of bottle with droppers. Add 1 drop of PAD Titrant to the sample. Hold the dropper straight up and down when adding the PAD Titrant. Mix by gently sliding (shaking) the mixing bottle back and forth on the table. Continue to add drops of the PAD Titrant until the solution is colorless. Count each drop added. Each drop is equal to 1 mg./l. of dissolve oxygen. How many mg./l. of dissolved oxygen did you find?

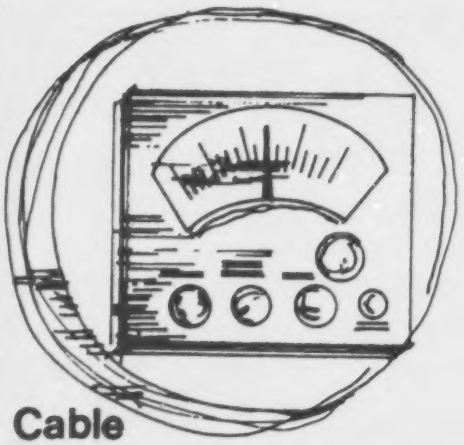
11. Record your results.

Plastic Tube

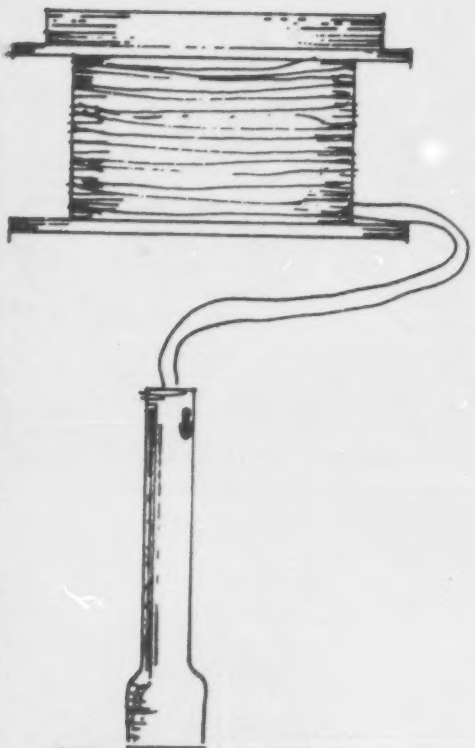
Mixing Bottle

THERMOCLINE - Generally speaking, warm water rises and cold water sinks. Therefore you can expect to find cold water near the bottom of a lake. The layer of water found at the boundry of the warm and cold water of the lake is called the thermocline. It can be recognized by a sudden drop in temperature. The thermocline is important because it acts as a barrier and prevents dissolved gases such as oxygen from reaching the colder waters. The thermocline thus may have an effect upon where organisms can live in the lake.

Whitney Thermocline



Cable



Thermocouple (Probe)

You will use a Whitney Thermometer to locate the thermocline. The thermometer is battery operated. The end that is placed in the water has a thermocouple (a temperature sensing device). The thermocouple is attached to a temperature scale by a cable that is marked off in meters.

PROCEDURE

The Whitney thermometer will be operated by a staff member assisted by three students:

a. student to lower the probe and read the depth in meters
b. student to read the temperature
c. student to record data.

1. Lower the probe into the water to just below the surface allow 30-60 seconds for the temperature to adjust. This will be your surface reading. Record the temperature.

2. Now lower the probe to the 1 meter level. Wait 30 seconds for the temperature to adjust. Record the temperature.

3. Continue to take temperatures at one meter intervals until you reach the bottom. Remember to allow 30 seconds for the temperature to adjust.

4. Be sure that all members have this data. This data will be discussed later in the session.

5. Questions to consider. Between what depths was the thermocline located? _____

   How might you more specifically identify the range of the thermocline?

Station 2

TURBIDITY - Turbidity is cloudiness of the water. This effects how well light can pass through water. This is affected by suspended materials such as small animals and plants called plankton, wastes, and dissolved substances. This factor is important because it determines the depth to which small plants called algae can live. Algae are important in the food chain and oxygen cycle which will be discussed later in the program.

We will measure turbidity using a Secchi disk. The Secchi is a white disk 20 cm in diameter. It is attached to a hand held line marked off in meters. Its purpose is to determine at what depth the disk disappears from view. This gives an estimate of light penetration into the water.

PROCEDURE

1. Lower the Secchi disk over the side of the boat.
2. Slowly release line until the disk disappears from sight.
3. Record the depth.
4. Repeat this procedure for a second reading.
5. Average your reading and record them on the data sheet.

Plankton Net

PLANKTON- Plankton are small floating or drifting plants and animals. These constitute the food basis for other animals in the lakes. In this exercise we will collect forms of these organisms for identification in a later laboratory exercise. A plankton net raised from the bottom of the lake to the surface (vertical haul) will be used to collect the specimens. You will be assisted by a staff member.

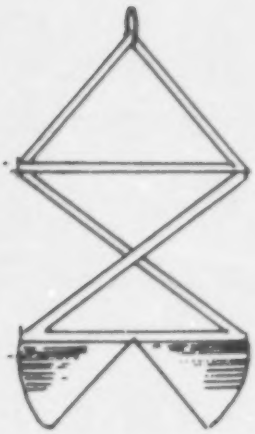
PROCEDURE

1. Attach the plankton net to the davit.
2. Lower plankton net to the bottom of the lake. Record the depth on your data sheet.
3. Raise the plankton net.
4. Remove the sample and place the specimens in the specimen bottle.
5. Lable the bottle with masking tape.

Vertical Haul Date _____ Time_____

Plankton Net. Location_____

BOTTOM SAMPLE - The bottom sediments contain many forms to organisms. It also gives an indication of how these sediments were deposited. To obtain the life forms we will use a Polmar Grab. To obtain a sample of sediments deposited a core sampler will be used. These instruments will be operated by staff members only. The specimens collected will be examined more carefully later at the Great Lakes Research Facility.



PONAR GRAB

PROCEDURE

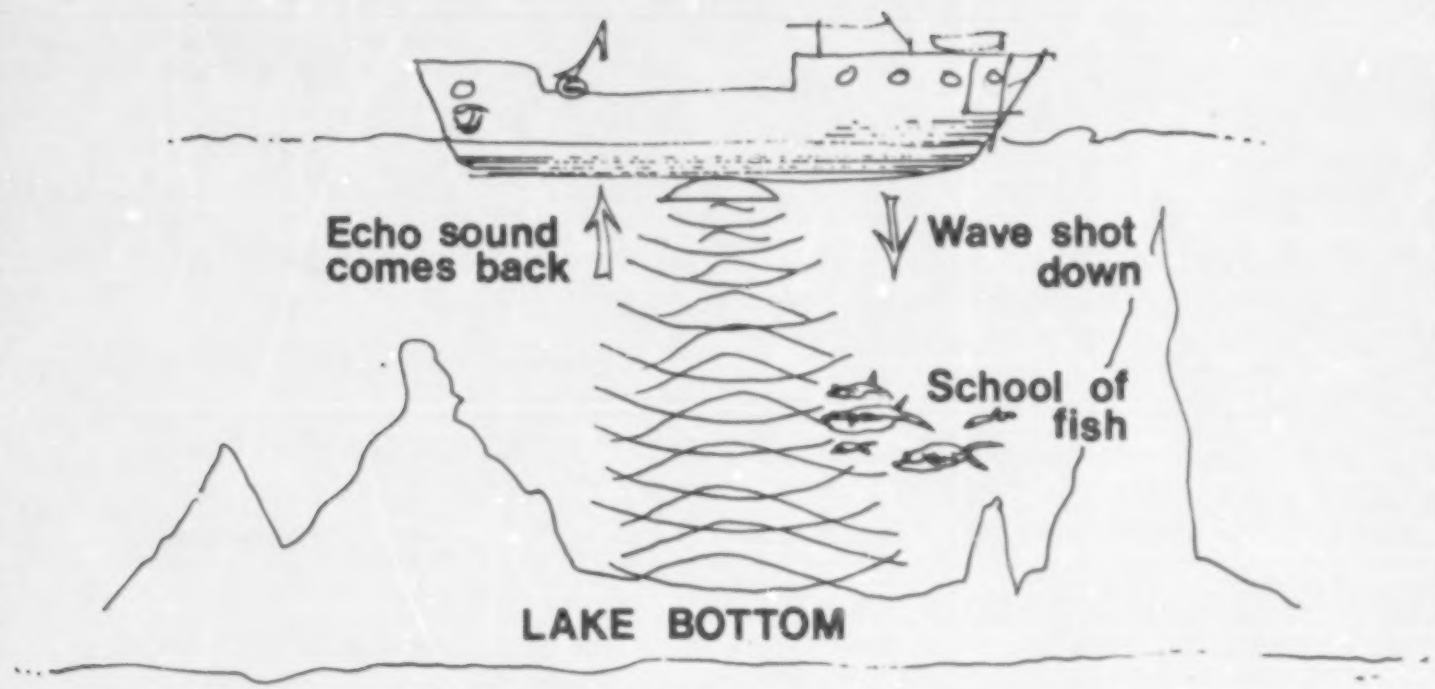
1. The Ponar Grab will be lowered to the bottom and the bottom sample collected will be brought on board. This sample will be emptied into sorting pans.
2. Carefully and gently sift through the sediment with your fingers.
3. Collect any specimens you find and place them in a collecting jar.
4. Label the collection jars with masking tape.

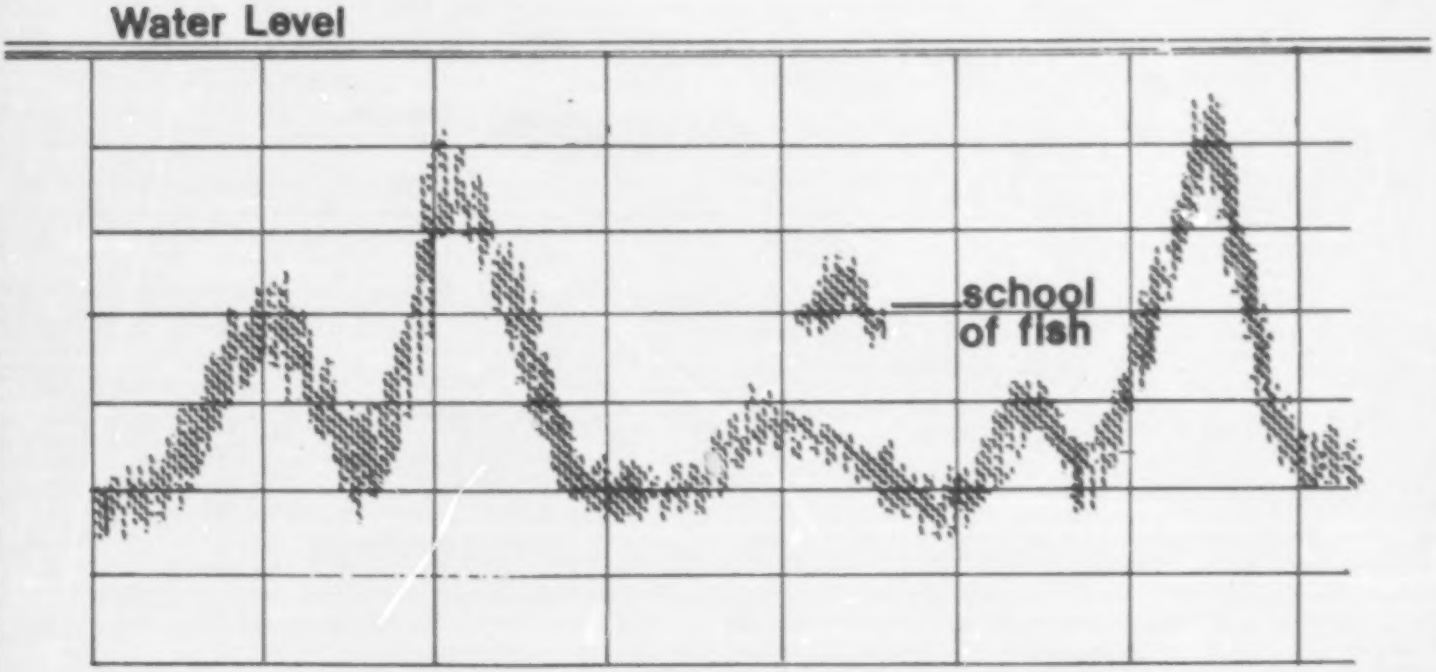
Bottom Sample Date_____ Time_____

Ponar Grab Location _____

Collector _____

Core Sampler

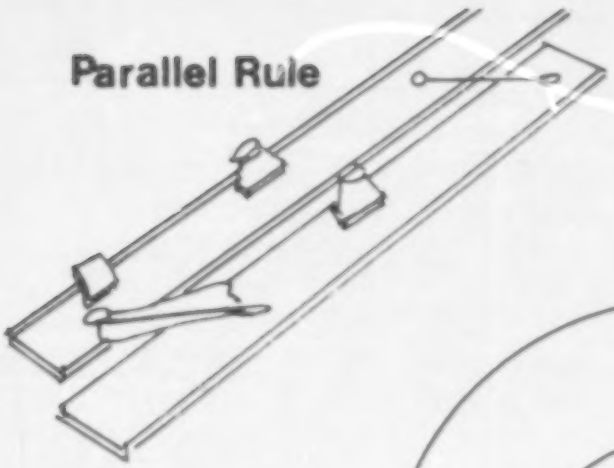


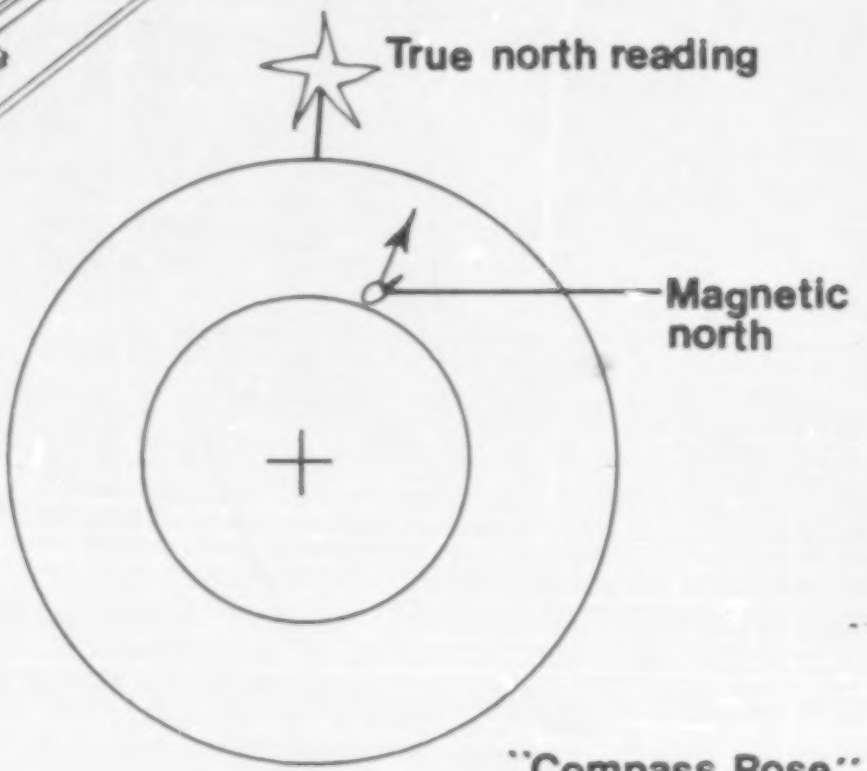


Fathometer

The Fathometer gives you a profile of the bottom of the lake

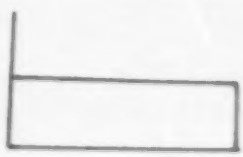
Parallel Rule

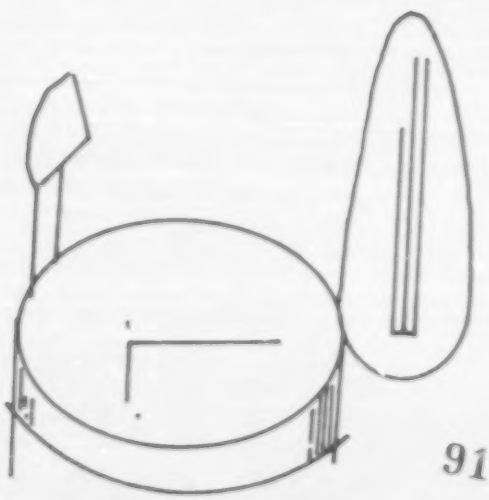


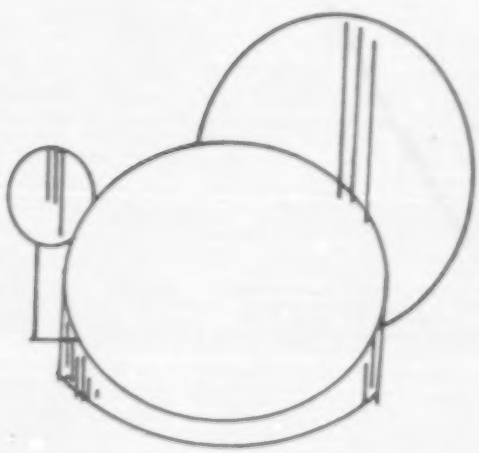


"Compass Rose"

Dividers







Hand Held Compass

Navigation Exercise
Forward Lower Deck

Navigation Student Science Lab Work Sheet

Navigational Equipment:

Nautical Maps - Milwaukee Harbor - Area
Parallel Rule
Dividers - Or Ruler
Nautical Computer
Hand Held Magnetic Compass

1. Be sure you have all of the equipment listed above.

2. Be sure you have a large cleared off area for your maps and equipment.

3. Looking at the map, begin to identify some of the simple features found on it. For example:

    1. TV towers
    2. Smoke Stacks
    3. Break Waters
    4. Harbor Entrance
    5. Great Lakes Research Facility

4. We want to plot a course for the skipper of the Aquarius, or at the very least check course he is presently steering. We also want to check the position of the Roger Simons when the actual samples are being taken. It is very important scientifically to know exactly where your samples came from.

5. Check our map and see if you can find the first anchor site of our investigation. Now see if you can find the harbor entrance.

6. Draw a light pencil line connecting these two points.

7. Now using the parallels align the outer edge of the parallels on your pencil mark and carefully "walk" the parallels to the center of the compass rose and obtain your degree reading. Be sure to read the magnetic compass bearing and the true north bearing (gyrocompass). Record these two readings on your data sheet.

8. Let's check our compass bearing with the navigator. Two students may go to the pilot house and ask the navigator his magnetic compass bearing and his gyrocompass bearing - record those bearings on your data sheet.

    How close were we to the actual bearing that we wanted?

9. While you are in the pilot house see if you can find the fathometer or depth recorder and locate the relative radar and the gyroscopic radar - look into the scope and see if you can recognize any land masses - you usually can pick out the Milwaukee breakwater.

10. Standing next to the pilot house and using your hand held compass, pick out two large objects on the landward side. Site down the compass and get your first bearing (works best off of the TV 6 tower) or the First Wisconsin Building.

11. Take a second compass bearing on another distant landmark, preferably some point south or at least 90° away from your first point. Record both your landmark bearings on the data sheet. Go back to the forward tower science lab and using the compass rose we will plot our exact location.

DATA SHEET

Compass Course to Anchor Site #1

1. _____° magnetic compass course bearing

2. _____° gyro compass course bearing

3. _____ _____° actual compass bearing that Roger Simons is steering (magnetic compass)

4. _____° actual compass bearing that Roger Simons is steering (gyroscopic compass)

5. _____° hand held compass reading taken at pilot house off of first landmark

6. _____° hand held compass reading taken at pilot house off of second landmark

Are we close to the actual position of the Roger Simons located on the map?

GLOSSARY

Bearing - a determination of position

Fathom - a measure of ocean depths. 6 feet or 1.83 meters.

Knot - a speed unit of one nautical mile per hour. A nautical mile equals 6076.12 ft.

Thermocline - a marked change in temperature in a layer of water within the ocean.

Turbid - suspended material contained in water reduces its clarity.

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The references and resources listed in this bibliography are divided into two sections - books and visual materials. The books included deal primarily with oceanography. However, with the exception of the flora and fauna, the principles discussed are applicable to the Great Lakes. The visual material used in the program and listed were primarily films and maps. Since most maps are available through local distributors, only special sources are included.

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12231 Wilkins Avenue
Rockville, Maryland 20852

How to Fillet Fish